Complete Summary

GUIDELINE TITLE

Advanced life support: 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations.

BIBLIOGRAPHIC SOURCE(S)

Advanced life support. In: 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Suppl):III25-54. [601 references]

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Cardiac arrest (cardiorespiratory arrest)

GUIDELINE CATEGORY

Management
Treatment

CLINICAL SPECIALTY

Cardiology
Emergency Medicine
Family Practice
Internal Medicine

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Emergency Medical Technicians/Paramedics
Health Care Providers
Hospitals
Nurses
Physicians
Public Health Departments

GUIDELINE OBJECTIVE(S)

To provide guidance on the use of advanced life support techniques in patients with cardiac/cardiopulmonary arrest

TARGET POPULATION

Individuals with cardiac/cardiopulmonary arrest

INTERVENTIONS AND PRACTICES CONSIDERED

Assessment and Prevention

1. Identification of the etiology of cardiac arrest
2. Introduction of a medical emergency teams
3. Introduction of an early warning scoring (EWS) system

Management

1. Bag-valve mask ventilation
2. Airway devices
    - Nasopharyngeal airway
    - Tracheal intubation
    - Combitube use
    - Laryngeal mask airway use
    - Laryngeal tube use
3. Confirmation of advanced airway placement
    - Evaluation of exhaled CO_2
    - Use of esophageal detector devices
4. Securing of advance airway devices
5. Ventilation strategies
    - Use of automatic transport ventilators
6. Pharmacological treatment of cardiac arrest
    - Vasopressors (epinephrine and vasopressin)
    - Antiarrhythmics (amiodarone)

- Other drugs and fluids, such as sodium bicarbonate (for life-threatening hyperkalemia or cardiac arrest associated with hyperkalemia, preexisting metabolic acidosis, or tricyclic antidepressant overdose), magnesium (for hypomagnesemia or torsades de pointes), fibrinolytics (for proven or suspected pulmonary embolism)
- Intraosseous delivery of drugs
- Intratracheal (via tracheal tube) delivery of drugs

7. Cardiopulmonary resuscitation (CPR) performance monitoring
    - End tidal CO_2 monitoring
    - Arterial blood gas monitoring
    - Calculation of coronary perfusion pressure
8. Techniques and devices to assist circulation during cardiac arrest
    - CPR prompt devices
    - Open chest CPR
    - Other techniques and devices to assist circulation (considered but not recommended)
9. Treatment for periarrest arrhythmias
    - Drug therapy for atrial fibrillation (magnesium, diltiazem, beta-blockers, amiodarone, ibutilide, propafenone, flecainide, digoxin, clonidine)
    - Therapy for regular narrow-complex tachycardia (vagal maneuver, adenosine, calcium channel blockers [verapamil or diltiazem], amiodarone, and electrical cardioversion)
    - Electrical cardioversion for unstable wide-complex tachycardia
    - Drug therapy for stable ventricular tachycardia (amiodarone, procainamide, and sotalol)
    - Amiodarone for polymorphic ventricular tachycardia
    - Therapy for torsades de pointes (magnesium, isoproterenol, and ventricular pacing)
    - Drug therapy for symptomatic bradycardia (atropine, transcutaneous pacing, dopamine, epinephrine, isoproterenol, theophylline, IV glucagons)
10. Fist pacing
11. Modification of resuscitation techniques for cardiac arrest in special circumstances:
    - Hypothermia
    - Drowning
    - Pregnancy
    - Asthma
    - Drug overdose and poisoning
12. Postresuscitation care
    - Ventilation to normocarbia
    - Therapeutic hypothermia
    - Prevention and treatment of hyperthermia
    - Seizure control and sedation
    - Other supportive therapies (blood glucose control, prophylactic antiarrhythmic therapy)
13. Prognostication during cardiac arrest and after resuscitation
    - Measurement of somatosensory-evoked potentials
    - Electroencephalogram
    - Neurologic exam during cardiac arrest (not recommended)

- Laboratory analyses of neuron-specific enolase and protein S-100b (not recommended)

MAJOR OUTCOMES CONSIDERED

- Survival rate
- Return of spontaneous circulation
- Successful ventilation
- Intubation success rate and complication rate
- Side effects of treatments

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

All reviewers were instructed to search their allocated questions broadly. Reviewers documented their search strategies to ensure reproducibility of the search. The minimum electronic databases searched included the Cochrane database for systematic reviews and the Central Register of Controlled Trials (http://www.cochrane.org/), MEDLINE (http://www.ncbi.nlm.nih.gov/PubMed/), EMBASE (www.embase.com), and the master reference library collated by the American Heart Association (AHA). To identify the largest possible number of relevant articles, reviewers were also encouraged to perform hand searches of journals, review articles, and books as appropriate.

The reviewers documented the mechanism by which studies relevant to the hypothesis were selected. Specific study inclusion and exclusion criteria and study limitations were documented. Inclusion of all relevant evidence (from animal and manikin/model studies as well as human studies) was encouraged.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Levels of Evidence

Level 1: Randomized clinical trials or meta-analyses of multiple clinical trials with substantial treatment effects

Level 2: Randomized clinical trials with smaller or less significant treatment effects

Level 3: Prospective, controlled, nonrandomized cohort studies

Level 4: Historic, nonrandomized cohort or case-control studies

Level 5: Case series; patients compiled in serial fashion, control group lacking

Level 6: Animal studies or mechanical model studies

Level 7: Extrapolations from existing data collected for other purposes, theoretical analyses

Level 8: Rational conjecture (common sense); common practices accepted before evidence-based guidelines

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

A worksheet template was provided with step-by-step directions to help the experts document their literature review, evaluate studies, and determine levels of evidence. When possible, 2 expert reviewers were recruited to undertake independent evaluations for each topic.

Assessing the Quality of Evidence

In this step reviewers were asked to determine the level of evidence of relevant studies (Step 2A), assess the quality of study research design and methods (Step 2B), determine the direction of results (Step 2C), and cross-tabulate assessed studies (Step 2D).

The levels of evidence used for the 2005 consensus process were modified from those used in 2000. In many situations summary conclusions were based on lower levels of evidence because human clinical trial data was not available. The reviewers assessed the quality of research design and methods and allocated each study to 1 of 5 categories: excellent, good, fair, poor, or unsatisfactory. Studies graded as poor or unsatisfactory were excluded from further analysis.

Reviewers evaluated the direction of the study results as supportive, neutral, or opposed and then depicted the data in 1 of 2 grids. The grids were 2-dimensional, showing quality and levels of evidence. The reviewers completed a Supporting Evidence grid and a Neutral or Opposing Level of Evidence grid.

Controversies Encountered

Studies on Related Topics (Level of Evidence [LOE] 7)

Many reviewers identified studies that answered related questions but did not specifically address the reviewer's initial hypothesis. Examples include the extrapolation of adult data for pediatric worksheets and extrapolation of the results of glucose control in critically ill patients to the postresuscitation setting. Worksheet reviewers were instructed to clearly designate evidence that represented extrapolations. Reviewers could designate such studies as LOE 7, or they could assign a level of evidence based on the study design but include terms such as "extrapolated from" with specific relevant details in the draft consensus on science statements to indicate clearly that these were extrapolations from data collected for other purposes.

Animal Studies and Mechanical Models

Animal studies can be performed under highly controlled experimental conditions using extremely sophisticated methodology. Irrespective of methodology, all animal studies and all studies involving mechanical models (e.g., manikin studies) were classified as LOE 6. Specific details about these studies (including methodology) are included in the summary of science where appropriate.

Studies Evaluating Diagnosis or Prognosis

The default levels of evidence used for the 2005 consensus process were not designed for the review of studies that evaluate diagnosis or prognosis. For these studies other methods of assigning levels of evidence were considered (such as those proposed by the Oxford Centre for Evidence-Based Medicine [http://www.cebm.net/]). Worksheet reviewers planning to include alternative levels of evidence were asked to define such levels clearly and to retain the default levels of evidence.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus
Expert Consensus (Consensus Development Conference)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Worksheet reviewers created a summary of the science. In the summary format reviewers were encouraged to provide a detailed discussion of the evidence, including the outcomes evaluated and the strengths and limitations of the data.

The final step in the science summary process was the creation of draft consensus on science statements and treatment recommendations. Statement templates were provided to standardize the comprehensive summary of information. Elements of the consensus on science statement template included the specific intervention or assessment tool, number of studies, levels of evidence, clinical outcome, population studied, and the study setting. Elements of the treatment

recommendation template included specific intervention or assessment tool, population and setting, and strength of recommendation.

The statements drafted by the reviewers in the worksheets reflect the recommendations of the reviewers and may or may not be consistent with the conclusions of the 2005 Consensus Conference.

All 380 participants at the 2005 Consensus Conference received a copy of the worksheets on CD-ROM. Expert reviewers presented topics in plenary, concurrent, and poster conference sessions. Presenters and participants then debated the evidence, conclusions, and draft summary statements. Each day the most controversial topics from the previous day, as identified by the task force chairs, were presented and debated in one or more additional sessions. The International Liaison Committee on Resuscitation (ILCOR) task forces met daily during the conference to discuss and debate the experts' recommendations and develop interim consensus science statements. Each science statement summarized the experts' interpretation of all the relevant data on a specific topic. Draft treatment recommendations were added if a consensus was reached.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Completed worksheets were posted on the Internet for further review. The initial process involved posting the worksheet to a password-protected area of the American Heart Association Intranet (accessible to worksheet reviewers). In December 2004 the completed worksheets were posted on an Internet site that could be accessed by the public for further review and feedback before the 2005 Consensus Conference in Dallas (www.C2005.org).

Wording of science statements and treatment recommendations was refined after further review by International Liaison Committee on Resuscitation (ILCOR) member organizations and the international editorial board. This format ensured that this final document represents a truly international consensus process.

The manuscript was ultimately approved by all ILCOR member organizations and by an international editorial board. The American Heart Association (AHA) Science Advisory and Coordinating Committee and the editor of *Circulation* obtained peer reviews of this document before it was accepted for publication. The document is

being published simultaneously in *Circulation* and *Resuscitation*, although the version in *Resuscitation* does not include the sections on stroke and first aid.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Causes and Prevention

Identification of the Etiology of Cardiac Arrest

The physical circumstances, history, or precipitating events may enable the rescuer to determine a noncardiac cause of the cardiorespiratory arrest. Under these circumstances the rescuer should undertake interventions based on the presumed noncardiac etiology.

Impact of Medical Emergency Teams (METs)

Introduction of a MET system for adult hospital in-patients should be considered, with special attention to details of implementation (e.g., composition and availability of the team, calling criteria, education and awareness of hospital staff, and method of activation of the team). Introduction of an early warning scoring (EWS) system for adult in-hospital patients may be considered.

Airway and Ventilation

Basic Airway Devices

Nasopharyngeal Airway

In the presence of a known or suspected basal skull fracture, an oral airway is preferred, but if this is not possible and the airway is obstructed, gentle insertion of a nasopharyngeal airway may be lifesaving (i.e., the benefits may far outweigh the risks).

Advanced Airway Devices

Tracheal Intubation Versus Ventilation With Bag-Valve Mask

There is insufficient evidence to support or refute the use of any specific technique to maintain an airway and provide ventilation in adults with cardiopulmonary arrest. Either bag-valve mask alone or in combination with tracheal intubation is acceptable for ventilation during cardiopulmonary resuscitation (CPR) by prehospital providers. Rescuers must weigh the risks and benefits of intubation versus the need to provide effective chest compressions. The intubation attempt will require interruption of chest compressions, but once an advanced airway is in place, ventilation will not require interruption (or even pausing) of chest compressions. To avoid substantial interruptions in chest compressions, providers may defer an intubation attempt until return of spontaneous circulation (ROSC). To ensure competence, healthcare systems that utilize advanced airways should

address factors such as adequacy of training and experience and quality assurance. Providers must confirm tube placement and ensure that the tube is adequately secured.

Tracheal Intubation Versus the Combitube/Laryngeal Mask Airway (LMA)

It is acceptable for healthcare professionals to use the Combitube or the LMA as alternatives to the tracheal tube for airway management in cardiac arrest.

Confirming Advanced Airway Placement

Unrecognized esophageal intubation is the most serious complication of attempted tracheal intubation. Routine confirmation of correct placement of the tracheal tube should reduce this risk. There are inadequate data to identify the optimal method of confirming tube placement during cardiac arrest. All devices should be considered adjuncts to other confirmatory techniques.

Exhaled Carbon Dioxide (CO_2)

Healthcare providers should recognize that evaluation of exhaled CO_2 is not infallible for confirming correct placement of a tracheal tube, particularly in patients in cardiac arrest. Exhaled CO_2 should be considered as just one of several independent methods for confirming tracheal tube placement. Continuous capnometry may be useful for early detection of tracheal tube dislodgment during transport.

Esophageal Detector Device (EDD)

The use of the EDD should be considered as just one of several independent methods for tracheal tube confirmation.

Strategies to Secure Advanced Airways

Securing the Tracheal Tube

Either commercially made tracheal tube holders or conventional tapes or ties should be used to secure the tracheal tube.

Strategies for Ventilation

Automatic Transport Ventilators (ATVs)

The use of a manually triggered, flow-limited resuscitator or an ATV by professional healthcare providers is reasonable for ventilation of adults with an advanced airway in place during cardiac arrest. The use of ATVs for adults without an advanced airway in place is discussed in the guideline entitled Adult Basic Life Support (see National Guideline Clearinghouse [NGC] summary of the American Heart Association guideline).

Drugs and Fluids for Cardiac Arrest

Vasopressors

Epinephrine and Vasopressin

Despite the absence of placebo-controlled trials, epinephrine has been the standard vasopressor in cardiac arrest. There is insufficient evidence to support or refute the use of vasopressin as an alternative to, or in combination with, epinephrine in any cardiac arrest rhythm.

Antiarrhythmics

Amiodarone

In light of the short-term survival benefits, amiodarone should be considered for refractory ventricular fibrillation/ventricular tachycardia (VF/VT).

Other Drugs and Fluids

Buffers

Giving sodium bicarbonate routinely during cardiac arrest and CPR (especially in out-of-hospital cardiac arrest) or after ROSC is not recommended. Sodium bicarbonate may be considered for life-threatening hyperkalemia or cardiac arrest associated with hyperkalemia, preexisting metabolic acidosis, or tricyclic antidepressant overdose.

Magnesium

Magnesium should be given for hypomagnesemia and torsades de pointes, but there is insufficient data to recommend for or against its routine use in cardiac arrest.

Fibrinolysis During CPR

Fibrinolysis should be considered in adult patients with cardiac arrest with proven or suspected pulmonary embolism. There is insufficient data to support or refute the routine use of fibrinolysis in cardiac arrest from other causes.

Alternative Routes for Drug Delivery

Drugs Given via the Tracheal Tube

If intravenous (IV) access is delayed or cannot be achieved, intraosseous (IO) access should be considered. Give drugs via the tracheal tube if intravascular (IV or IO) access is delayed or cannot be achieved. There are no benefits from endobronchial injection compared with injection of the drug directly into the tracheal tube. Dilution with water instead of 0.9% saline may achieve better drug absorption.

Monitoring and Assisting the Circulation

Monitoring CPR Performance

End-Tidal CO_2 Monitoring to Guide Therapy During Cardiac Arrest

End-tidal CO_2 monitoring is a safe and effective noninvasive indicator of cardiac output during CPR and may be an early indicator of ROSC in intubated patients.

Arterial Blood Gas Monitoring During Cardiac Arrest

Arterial blood gas monitoring during cardiac arrest enables estimation of the degree of hypoxemia and the adequacy of ventilation during CPR but is not a reliable indicator of the extent of tissue acidosis.

Coronary Perfusion Pressure (CPP) to Guide Resuscitation

Coronary perfusion pressure can guide therapy during cardiac arrest. In an intensive care facility the availability of direct arterial and central venous pressure monitoring makes calculation of CPP potentially useful. Outside the intensive care facility the technical difficulties of invasive monitoring of central arterial and venous pressure make it difficult to calculate CPP routinely during cardiac arrest.

Techniques and Devices to Assist Circulation During Cardiac Arrest

Transcutaneous Pacing for Asystole

Pacing is not recommended for patients in asystolic cardiac arrest.

CPR Prompt Devices

CPR prompt devices may improve CPR performance. See also "Interdisciplinary topics" in the "Availability of Companion Documents" field.

Open-Chest CPR

Open-chest CPR should be considered for patients with cardiac arrest in the early postoperative phase after cardiothoracic surgery or when the chest or abdomen is already open.

Periarrest Arrhythmias

Narrow-Complex Tachycardia

There are 4 options for the treatment of narrow-complex tachycardia in the periarrest setting: electrical conversion, physical maneuvers, pharmacologic conversion, or rate control. The choice depends on the stability of the patient and the rhythm. In a hemodynamically unstable patient, narrow-complex tachycardia is best treated with electrical cardioversion.

Drug Therapy for Atrial Fibrillation

Magnesium, diltiazem, or beta-blockers may be used for rate control in patients with atrial fibrillation with a rapid ventricular response. Amiodarone, ibutilide, propafenone, flecainide, digoxin, clonidine, or magnesium may be used for rhythm control in patients with atrial fibrillation.

Drug Therapy for Regular Narrow-Complex Tachycardia

Stable narrow-complex tachycardia (excluding atrial fibrillation or atrial flutter) should be treated first with vagal maneuvers (avoiding carotid sinus massage in the elderly); these will terminate about 20% of paroxysmal supraventricular tachycardias (PSVTs). If vagal maneuvers are not used or if they fail, give adenosine.

A calcium channel blocker (verapamil or diltiazem) infusion or amiodarone may be used as a second-line treatment for the 10% to 15% of patients who do not respond to adenosine. In unstable PSVT, electrical cardioversion is the treatment of choice; IV rapid bolus adenosine can be tried if electrical cardioversion is not immediately available.

Broad-Complex Tachycardia

The stability of the patient determines the choice of treatment for wide-complex (broad-complex) tachycardia. In unstable wide-complex tachycardia electrical cardioversion is the treatment of choice.

Drug Therapy for Stable Ventricular Tachycardia

Amiodarone, procainamide, and sotalol are effective in terminating stable sustained VT.

Drug Therapy for Polymorphic Ventricular Tachycardia

For hemodynamically stable polymorphic VT, where electrical therapy is not desirable or is ineffective, treatment with amiodarone may be effective.

Therapy for Torsades de Pointes

Magnesium, isoproterenol, and ventricular pacing can be used to treat torsades de pointes.

Bradycardia

In the periarrest setting the rescuer should seek and treat reversible causes of bradycardia. In the absence of reversible causes, atropine remains the first-line drug for acute symptomatic bradycardia. Failure to respond to atropine will usually necessitate transcutaneous pacing, although second-line drug therapy with dopamine, epinephrine, isoproterenol, or theophylline may be successful. Fist pacing may be attempted pending the arrival of an electrical pacing unit.

Drug Therapy for Symptomatic Bradycardia

For symptomatic bradycardia, give atropine 0.5 to 1 mg IV, repeated every 3 to 5 minutes, to a total of 3 mg. Be prepared to initiate transcutaneous pacing quickly in patients who do not respond to atropine (or second-line drugs if these do not delay definitive management). Pacing is also recommended for severely symptomatic patients, especially when the block is at or below the His-Purkinje level. Second-line drugs for symptomatic bradycardia include dopamine, epinephrine, isoproterenol, and theophylline. Consider IV glucagon if beta-blockers or calcium channel blockers are a potential cause of the bradycardia. Atropine should not be used in patients with cardiac transplants.

Fist Pacing in Cardiac Arrest

Fist pacing may be considered in hemodynamically unstable bradyarrhythmias until an electrical pacemaker (transcutaneous or transvenous) is available.

Cardiac Arrest in Special Circumstances

Environmental

Hypothermia

For hypothermic patients with a perfusing rhythm and without a preceding cardiac arrest, consider active (noninvasive) external warming (with heating blankets, forced air, and warmed infusion). Severely hypothermic patients in cardiac arrest may benefit from invasive warming (cardiopulmonary bypass or extracorporeal circulation).

Drowning

Victims of submersion should be removed from the water and resuscitated by the fastest means available. Only victims with risk factors (history of diving, water slide use, trauma, alcohol) or clinical signs of injury or focal neurologic signs should be treated as having a potential spinal cord injury, with stabilization of the cervical and thoracic spine.

Pregnancy

Etiology of Cardiac Arrest in Pregnancy

Rescuers should try to identify common and reversible causes of cardiac arrest in pregnancy during resuscitation attempts. The use of abdominal ultrasound by a skilled operator should be considered in detecting pregnancy and possible causes of cardiac arrest in pregnancy, but this should not delay other treatments.

Resuscitation Technique for Pregnancy

If initial resuscitative efforts fail, caesarean delivery of the fetus (hysterotomy) should be performed within 5 minutes of onset of cardiac arrest in pregnancy to improve maternal or fetal survival. A left lateral tilt of 15 degrees is required to relieve inferior vena caval compression in the majority of pregnant women. The energy levels used for defibrillation in adults are appropriate for use in pregnancy.

Asthma

Defibrillation in Asthma

If initial attempts at defibrillation fail for the patient with asthma and VF, higher shock energies should be considered.

Ventilation in Asthma

There are insufficient data to support or refute the use of helium-oxygen mixtures in asthma-related cardiac arrest. Compression of the chest wall or a period of apnea may relieve gas trapping if dynamic hyperinflation occurs. In asthma-related cardiac arrest the patient's trachea should be intubated early to facilitate ventilation and minimize the risk of gastric inflation.

Drug Overdose and Poisoning

Sodium Bicarbonate for Poisoning and Electrolyte Disturbances

Sodium bicarbonate is recommended for the treatment of tricyclic antidepressant-induced arrhythmia or hypotension. Although no study has investigated the optimal target pH with bicarbonate therapy, a pH of 7.45 to 7.55 has been commonly accepted and seems reasonable.

Postresuscitation Care

Ventilation

Control of Arterial Carbon Dioxide

There are no data to support the targeting of a specific partial pressure of arterial carbon dioxide ($PaCO_2$) after resuscitation from cardiac arrest. Data extrapolated from patients with brain injury, however, imply that ventilation to normocarbia is appropriate. Routine hyperventilation may be detrimental and should be avoided.

Temperature Control

Therapeutic Hypothermia

Unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest should be cooled to 32 degrees C to 34 degrees C for 12 to 24 hours when the initial rhythm was VF. Cooling to 32 degrees C to 34 degrees C for 12 to 24 hours may be considered for unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest from any other rhythm or cardiac arrest in hospital.

Prevention and Treatment of Hyperthermia

Hyperthermia should be avoided after cardiac arrest.

Seizure Control and Sedation

Prevention and Control of Seizures

Seizures increase the oxygen requirements of the brain and can cause life-threatening arrhythmias and respiratory arrest; therefore, seizures following cardiac arrest should be treated promptly and effectively. Maintenance therapy should be started after the first event once potential precipitating causes (e.g., intracranial hemorrhage, electrolyte imbalance) are excluded.

Other Supportive Therapies

Blood Glucose Control

Providers should monitor blood glucose frequently after cardiac arrest and should treat hyperglycemia with insulin but avoid hypoglycemia.

Prophylactic Antiarrhythmic Therapy

Giving prophylactic antiarrhythmics to patients who have survived cardiac arrest, irrespective of etiology, can neither be recommended nor rejected. It may be reasonable, however, to continue an infusion of an antiarrhythmic drug that successfully restored a stable rhythm during resuscitation.

Prognostication

Prognostication During Cardiac Arrest

Predictive Value of Neurologic Examination

Relying on the neurologic exam during cardiac arrest to predict outcome is not recommended and should not be used.

Prognostication After Resuscitation

Predictive Value of Neuron-Specific Enolase (NSE) and Protein S-100b

No laboratory analyses (NSE, S-100b, base deficit, glucose, or soluble P-selectin) provide reliable prediction of the outcome after cardiac arrest.

Somatosensory-Evoked Potential

Median nerve somatosensory-evoked potentials measured 72 hours after cardiac arrest can be used to predict a fatal outcome in patients with hypoxic-anoxic coma.

Electroencephalogram (EEG)

The use of the EEG performed a minimum of 24 to 48 hours after a cardiac arrest can help define the prognosis in patients with grade I, IV, and V EEGs.

CLINICAL ALGORITHM(S)

The International Liaison Committee on Resuscitation (ILCOR) Universal Cardiac Arrest Algorithm is provided in the "Introduction" section of the original guideline document (see "Availability of Companion Documents" field).

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of evidence supporting the recommendations is not specifically stated.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate application of advanced life support techniques to increase the chance of successful intervention following cardiopulmonary arrest

POTENTIAL HARMS

- Insertion of a nasopharyngeal airway may cause airway bleeding
- Trachea intubation is associated with unrecognized esophageal intubation misplacement and unrecognized dislodgment. Prolonged attempts at tracheal intubation are harmful: the cessation of chest compressions during this time will compromise coronary and cerebral perfusion.

CONTRAINDICATIONS

CONTRAINDICATIONS

Atropine should not be used in patients with cardiac transplants.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

This document summarizes current evidence for the recognition and response to sudden life-threatening events, particularly sudden cardiac arrest in victims of all ages. The broad range and number of topics reviewed and the inevitable limitations of journal space require succinctness in science statements and, where recommendations were appropriate, brevity in treatment recommendations. This is not a comprehensive review of every aspect of resuscitation medicine; some topics were omitted if there was no evidence or no new information.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Clinical Algorithm

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Advanced life support. In: 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Suppl):III25-54. [601 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2005 Nov 29

GUIDELINE DEVELOPER(S)

American Heart Association - Professional Association

SOURCE(S) OF FUNDING

American Heart Association

GUIDELINE COMMITTEE

International Liaison Committee on Resuscitation (ILCOR)

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Not stated

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

A robust conflict of interest policy was developed to ensure full disclosure of potential conflicts and to protect the objectivity and credibility of the evidence evaluation and consensus development process. This policy is described in detail in an editorial companion document (see "Availability of Companion Documents" field). Representatives of manufacturers and industry did not participate in this conference.

Potential conflicts of interest of the editorial board are listed in Appendix 3 of the original guideline document (see "Availability of Companion Documents" field). Potential conflicts of interest of the worksheet authors are noted in the worksheets and can be accessed through the links to the worksheets contained in the original guideline document. All 380 attendees were required to complete forms in order to document their potential conflicts of interest. Most attendees were also worksheet authors. The information from the conflict of interest forms completed by all conference attendees, including worksheet authors, can also be accessed at the website http://circ.ahajournals.org/content/vol112/22_suppl/#APPENDIX. Readers of the print version can also access the statements at the American Heart Association website: www.C2005.org.

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available from the American Heart Association Web site.

Print copies: Available from the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596; Phone: 800-242-8721

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Introduction. 2005 International Consensus Conference on Cardiopulmonary Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Supplement):III-1-III-4.
- The evidence evaluation process for the 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Supplement):III-128-III-130.
- Conflict of interest management before, during, and after the 2005 International Consensus Conference on Cardiopulmonary Resuscitation and

Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Supplement):III-131-III-132.

- Controversial topics from the 2005 International Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Supplement):III-133-III-136.
- Appendix 1: Worksheet topics and authors. Circulation 2005 Nov 29;112(22 Supplement):B1-B14.
- Appendix 3: Conflict of interest for editors, editorial board, special contributors and reviewers, and honorees. Circulation 2005 Nov 29;112(22 Supplement):B16-B18.
- Interdisciplinary topics. 2005 International Consensus Conference on Cardiopulmonary Consensus Conference on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Circulation 2005 Nov 29;112(22 Supplement):III-100-III-108.

Electronic copies: Available from the American Heart Association Web site.

Print copies: Available from the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596; Phone: 800-242-8721

PATIENT RESOURCES

None available

NGC STATUS

This NGC summary was completed by ECRI on February 3, 2006. The information was verified by the guideline developer on March 7, 2006.

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